

TITLE OF THE INVENTION

FORCE-RESISTING SUPPORT ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is related to U.S. provisional patent application no. 60/411,661 filed September 18, 2002, and claims priority to such application under 35 USC § 119(e). The disclosure and teachings of provisional patent application no 60/411,661 are incorporated herein.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a load-force-resisting assembly, and specifically to a pallet or dunnage support constructed of paperboard that minimizes adverse environmental impact, occupies little space before it is configured, and effectively saves production, storage, and transportation costs.

Description of Related Art

A pallet is primarily used to handle materials in large quantities and typically comprises a flat, elevated surface to support containers or packages a sufficient distance from a surface such as a floor to permit the forks of a forklift to be inserted under them so that the pallet supporting the load can be moved from place to place. For the purpose of transporting products, using pallets to carry goods is simple, economical, and efficient.

Most pallets have been made of wood. Of the available materials prior to a new technology in paperboard construction being developed, softwood provided the best balance of both strength and cost.

However, a number of problems face users of conventional wooden pallets. The cost of making and repairing wooden pallets is rising at a rate that is detracting from the cost effectiveness of palletized shipment. Moreover, empty wooden pallets require substantial space for storage, and it is especially costly to transport empty pallets by rail or truck for reuse.

In an effort to reduce costs, many wood pallet producers have resorted to using lower grades of unseasoned or untreated lumber commonly known as "pallet lumber." Pallet lumber typically has a rough finish and is prone to cracking, warping, or the like. Further, such rough finishes present a splinter hazard and are unsuitable for some uses, including food-handling applications. Such low grades of lumber also readily split or break, resulting in pallet failure.

Conventional types of pallets must be returned to the shipper after use so the shipper can reuse them, if possible, or the pallets have to be disposed of in a proper manner. Yet, wood pallets are bulky which makes them inconvenient to store and return to the shipper. Damaged wooden pallets generally cannot be taken to a landfill or other waste disposal site. Rather, they must be reduced either by chipping or burning before disposal. Chipping is a significant problem inasmuch as nails and other metal fasteners must be removed from the pallet wood before the chipping operation can be undertaken, adding significant cost to pallet reduction. By the same token, increasingly stringent environmental regulations often preclude the burning of used pallets.

Disposal of the conventional wood and nail pallets is a more serious problem when such pallets are exposed to chemical or biochemical materials that contaminate the pallet, since contaminated parts of the pallet can not be destroyed through incineration. The contaminated parts of the pallets often must be disposed in a hazardous waste landfill, which disposal is also inconvenient and expensive.

As forest resources also have been declining in recent years, pallets constructed of plastic and metal have been developed. While it is true that higher pressure-resistant strength is an advantage of pallets made of plastic and metal, in terms of environmental protection these two other types of pallet material no longer meet the requirements of environmental preservation. Additionally, the heavier pallet materials of plastic and metal pallets do not satisfy economic efficiency when weight is the basis for the calculation of transportation costs.

Thus there has been a long-felt need for a pallet that is lightweight, inexpensive, and strong, and has smooth outward surfaces, that is formed of an alternate material other than wood, plastic, or metal.

A demand presently exists for recyclable materials such as corrugated paperboard boxes that may be readily remanufactured into recycled corrugated paperboard. Recyclability provides future cost efficiencies on a large scale. Paperboard is a largely homogenous material (with the exception of minor amounts of adhesive and printing ink, which are acceptable in the recycling process) and may be readily collected at a number of discrete sites (e.g., warehouse, factory, retail store, or the like). In some instances, pallets are used to support a number of corrugated containers (e.g., boxes) which may be attached to the pallet using suitable means (e.g., strapping, shrink-wrapping, or the like). Thus it is desirable to provide a pallet that can be recycled in the same material stream as its accompanying corrugated containers.

There have been a variety of attempts over the years to replace wooden pallets with those constructed of paperboard. However, past paperboard pallets were not as sturdy as wooden pallets, were more costly, and required inside storage, and none of them received widespread acceptance. In recent years, attempts also have been made to replace the bulky and expensive wooden pallets with solid paperboard sheets called slip-sheets. These slip-sheets simply comprise a sheet of solid paperboard that is slightly larger than the dimensions of the goods to be stacked thereon. The slip-sheet is neither intended for nor capable of supporting the weight of the stacked goods, and must always be supported on a suitable horizontal surface, by using a conventional pallet, or handled with specially designed equipment. By providing an extra marginal edge of solid board material, it is possible to grasp and slide the sheets and the goods carried thereon about the floor or onto a specially designed lift truck.

While slip-sheets have provided cost savings in many industrial situations, they simply are not suitable to fully replace palletized shipments. For example, difficulties have been encountered where heavily loaded slip-sheets are positioned directly adjacent the doorway of a fully loaded boxcar or truck trailer. When so positioned, the lift truck mechanism is unable to

grasp a sufficient portion of the slip-sheet to pull it onto the lift truck. A slip-sheet improperly grasped is often ripped. This has necessitated, in many situations, unloading the sheet to move the goods out of the carrier and then restacking the goods on the sheet for transport by a lift truck.

An all-corrugated paperboard pallet is desirable, as it can be recycled along with any corrugated containers carried on the pallet. In warehouses and retail stores it is known to provide a separate compactor for compacting and storing corrugated waste. Such waste can then be retrieved and recycled into new corrugated material. In addition to the designs noted above, several attempts have been made to produce an all-corrugated paperboard pallet by mimicking the design of a wood pallet, using layers of corrugated paperboard in place of wood boards. Such pallets are heavy and expensive, as they attempt to achieve the equivalent strength of a wood pallet, and comprise several layers of corrugated material (e.g., as many as 16 layers).

Another requirement of a practical pallet design is that the pallet be suitably moisture and water resistant. Water spills, rain, and condensation may be present in warehouses, loading docks, trucks, railcars, and the like. In many instances a pallet may be placed in proximity to a location where a risk of flooding may occur leaving the pallet placed in a small amount of standing water. Corrugated paperboard pallets of the prior art are not suitably equipped to sustain such moisture conditions. Moreover, alternative pallet designs of paper core, wood, and paper pulp will often disintegrate under such conditions.

A novel corrugated paperboard pallet design is desired that is capable of overcoming the numerous disadvantages of the conventional pallet, and can be made from a converted or remanufactured paper product. In most applications, the corrugated paperboard is a layered structure that is usually die-cut to form corrugated structures. It consists of a fluted corrugated medium sandwiched between sheets of linerboard. The simplest three-ply structure is known as "double wall." As recently as 1990, much of the linerboard was made entirely from virgin, long-fibered, softwood, kraft pulp. At present, however, these board grades contain sizeable portions of recycled old corrugated containers (OCC) and many are made from 100% OCC.

Around the country, and even in the rest of the world, landfill space for waste disposal is rapidly reaching capacity. By the year 2000, paper and paperboard products are projected to represent 40.9 percent of the municipal solid waste stream and may climb to nearly 42 percent by 2010. New governmental regulations and the public's increasing concern for the environment have created pressure to remove these materials from the solid waste stream. The most widely utilized method of reducing paper waste is recycling.

OCC has a history of efficient recycling use. Even before the era of government mandates and self-imposed industry goals, almost 50% of OCC was recycled in North America. The recovery rate as of 1999 was about 62%. Past estimates indicated that a level of 70% would be achieved by the year 2000. Most of this recycled material goes directly from retail chain stores and factories to mills based on long-term contracts. The rest comes from municipal curbside collection and wastepaper dealers. Some OCC is used in the production of boxboard, and some is even bleached and used in the production of fine paper, but most OCC is used again to produce corrugating medium and linerboard. "Repulping" refers to any mechanical action that disperses dry or compacted pulp fibers into a water slush, slurry or suspension. The action can be just sufficient to enable the slurry to be pumped, or it can be adequate to totally separate and disperse all the fibers. In a typical recycling process, bales of OCC are fed into a repulper, where the material is disintegrated and the gross contaminants are removed. The resulting stock is pumped through pressure screens and cyclonic cleaners to remove oversized materials and foreign matter. Reverse cleaners remove plastics, STYROFOAM® or other lightweight contaminants. The glue, staples, wax, and tapes originally used to assemble the corrugated box must be removed.

Untreated OCC usually creates no problems for recycling. However, paperboard is often treated or coated to enhance its performance and these coatings render the paper unrecyclable. For example, corrugated paperboard is often treated with a curtain coating, wax impregnation, lamination, sizing, or a water-based coating to reduce abrasiveness and to provide for oil and moisture resistance. Moisture vapor transfer rate (MVTR) is a scientific measurement used to describe a product's ability to allow moisture vapor to pass through it, over a specific time period,

at a controlled temperature and at a designated atmospheric pressure. While coatings such as wax enhance the moisture-resistance properties of the paperboard, the wax coating process is expensive and often renders the paperboard unrecyclable.

In pallet construction, excessive moisture gain can cause a corrugated paperboard pallet to lose its integrity and fail during use, which potentially could lead to heavy economic losses. Traditional solutions generally involve plastic film, either as a laminate with the paperboard or as a bag around the pallet. Both solutions are expensive or incur added labor costs, and greatly reduce or eliminate the recyclability of the pallet. Therefore, there exists a need in the art for coatings that can provide the high moisture resistance needed without compromising the recyclability of the pallet.

The MVTR of a corrugated paperboard pallet is dependent not only upon the coating on the paperboard, but also the method by which that coating is applied. Traditional methods of coating application, such as a rod coater or a blade coater, may result in variations in coating thickness that will cause variations in the MVTR of the coating. The typical solution to this problem has been to merely increase the amount of coating applied to the paperboard. This solution can be expensive and does not result in a consistently coated product both linearly and across the paperboard web.

Conventional dunnage support assemblies are frequently employed when transporting industrial articles from one location to another. Known dunnage support assemblies typically comprise a dunnage support member that is secured to a rigid frame. The dunnage support member itself is formed of an elastomeric material and has a surface adapted to engage and support the dunnage for transportation. The elasticity of the dunnage support member protects the dunnage from damage that might otherwise result from jarring and vibration during transport.

There have been a number of previously known shipping containers for dunnage, specifically shipping containers for heavy industrial components, such as automotive engines. These previously known shipping containers typically comprise a frame constructed of a rigid

material, such as tubular steel. Furthermore, each container is usually designed to transport a number of the industrial components.

Typically, these elastomeric dunnage support members are formed from polyisocyanate that reacts with a resin. The reaction itself is carried out within a mold so that the mold, which conforms in shape to the dunnage support member, forms the part in the desired final shape. Such dunnage support members further can be custom fabricated for the particular dunnage to be transported.

The disposal of previously known dunnage supports after their useful life, however, presents problems, not unlike the problems associated with damaged wood and plastic pallets. The elastomeric material formed by the reaction of polyisocyanate and resin cannot be recycled and, instead, must be disposed of in a landfill or an equivalent. Such disposal is not only expensive, but also presents potential hazards to the environment.

U.S. industry has been moving toward the elimination of foam dunnage supports and packaging comprising polystyrene and other foams, principally because of adverse environmental impacts of such type packaging, and accordingly, efforts are directed toward providing a dunnage support that is recyclable. Industries utilizing dunnage supports are varied, and span from the furniture industry to the automobile industry. Any product that is shipped can be protected from scratches, dents, and other forms of damage by some sort of dunnage support assembly.

The elastomeric material formed for use as a dunnage support generally is an isomeric material that is spongy. Consequently, once the products are wedged between spaced-apart dunnage support members, the spongy elastomeric material compresses slightly and cushions the dunnage. Another disadvantage of the conventional dunnage support assembly is that the shipping container is often subjected to high impact during transport. This is especially true when train transports the shipping container. In such situations, the spongy dunnage support members have been known to crumble or otherwise abrade during transport. Such abrasion or crumbling of the elastomeric material is unacceptable since it can result in damage to the dunnage.

Currently wooden and plastic dunnage supports are also known to be used. These materials form supports, however, that are substantially unyielding, which promotes the packaging of the supported components to rely solely upon the internal protection of the individual container in which the material being shipped is encased.

Thus it can be seen that there is a need for a force-resisting structure that upon construction can be used both as a pallet or a dunnage support, which structure comprises board that is capable of minimizing both environmental pollution and transportation expenses, occupying little space before it is configured, and effectively saving production and storage costs. Preferably, the paperboard pallets and dunnage support assemblies should have a low moisture vapor transmission rate, excellent glueability, and recyclability.

SUMMARY OF THE INVENTION

Briefly described, in its preferred form, the present invention forms a force-resisting assembly comprising a lower and upper frame member foldably constructed from corrugated or solid paperboard blanks. Each frame member comprises ribs having alignment/locking slots. The lower and upper frame members differ in dimensions, but in a preferred form incorporate nearly identical (or identical) elements, thus simplifying production of the blanks and the folding steps necessary to form the present structure. The ribs of the lower frame member align/lock into the alignment/locking slots of the ribs of the upper frame member, and the ribs of the upper frame member align/lock into the alignment/locking slots of the ribs of the lower frame member.

The paperboard of the present assembly can comprise numerous embodiments, including a medium between two sheets of linerboard or be multi-layered, and incorporate a variety of flute designs. The flute sizes and thickness can be customized to meet specific requirements of strength and flexibility. Preferably, the force-resisting structure assembled into a pallet provides for four-way entry for forklift maneuverability, and may be sent to the end user either in assembled form, or in flat blank form. Formed as a pallet, the present assembly is more aptly termed a load-bearing assembly supporting containers and the like above the floor.

The present invention constructed and used as a pallet eliminates numerous disadvantages associated with the use of conventional permanent pallets. The present pallet comprises relatively inexpensive materials such as paperboard, and is secured together without the need for glue or other adhesives. The present pallet is configured such that it is stabilized by special locking assemblies and peripheral structures (e.g. edge panels). Unlike typical corrugated pallets, the special design and construction of the present pallet alleviates any need for adhesives. This feature makes possible other advantageous features. For example, it is known in the industry that corrugated pallets cannot typically be used in moist environments, as water can soak into and ruin the pallet. To combat this problem, pallets can be treated with a certain coating, wax impregnation, lamination, polyester coating, sizing, or a water-based coating to reduce abrasiveness and to provide for oil and moisture resistance. However, adhesives such as glue have difficulty properly sticking to a treated corrugated material. Prior to the subject invention, there have not been assembled corrugated pallets that could maintain their integrity without use of an adhesive of some sort. Thus, the subject pallet or dunnage system provides an effective pallet that can be made using a treated material. Though not preferred, and not needed, it is understood that conventional adhesives such as glue can be used to further stabilize and secure the pallet. The use of such adhesives would not interfere with the recyclability of the paperboard; so the pallets remain recyclable, disposable in municipal landfills, and inexpensive to manufacture. The pallet of the present invention is also easy to dispose of in case of contamination due to product spills or damage because all of the materials of construction are biodegradable or can be incinerated without further disassembly. The pallets are lightweight and have great structural strength. Thus the pallets of the instant invention are especially suited for assembly line work for containing or supporting parts that must be supported or stacked in that the worker need not have to handle the weight of a traditional wood and nail pallet. Moreover, the manufacturer does not have the expense of providing lightweight plastic pallets, which are usually too costly to use for operations requiring disposal or destruction of the pallet due to contamination.

These advantages of the present assembly forming a pallet equally apply to the assembly forming a dunnage support. As a dunnage support is placed between two or more surfaces, the present invention resists the forces generated when the surfaces are brought toward one another during settlement or transportation shifting.

The method at which the current design is formed and assembled creates a resilient dunnage support that assists in protecting shock-sensitive components such as electrical/electronic devices, an improvement over previously known devices.

The objects, features, and advantages of the present invention will become more apparent upon reading the following specification in conjunction with the accompanying drawing figures.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a top-corner perspective view of the foldable paperboard force-resisting assembly of the present invention in its assembled configuration.

FIG. 2 shows a paperboard top blank according to a preferred form of the present invention.

FIG. 3 shows a paperboard bottom blank according to a preferred form of the present invention.

FIG. 4 is a cross-sectional view of a left-hand part of the folded bottom frame member of the blank of FIG. 2.

FIG. 5 is a view of the folded bottom frame member along line 5 – 5 of FIG. 4.

FIG. 6 is a view of the folded bottom frame member along line 6 – 6 of FIG. 4.

FIG. 7 illustrates a preferred jack panel of the blank of FIG. 2.

FIG. 8 illustrates a preferred middle panel of the blank of FIG. 2.

FIG. 9 is a perspective view of the bottom frame member of the present invention, in an assembled configuration.

FIG. 10 is a side view of a preferable rib portion of the present invention.

FIG. 11 is a perspective view of an assembled force resisting assembly according to one embodiment of the present invention.

FIG. 12 is a perspective view of a locking slot of a rib portion of the present invention.

FIG. 13 is a perspective view of a locking slot of another rib portion of the present invention, which rib portion engages the rib portion of FIG. 12 upon construction of the present assembly.

FIG. 14 is a side view of the engagement of the rib portions of FIGS. 12 and 13.

FIG. 15 is a perspective view of a diagram which shows an embodiment comprising tab locks to further increase stability and integrity of pallet.

FIG. 16 is a top view of a flat attachment embodiment which may be attached to the pallet so as to provide a flat top surface.

FIG. 17 is a top view of a tray attachment embodiment which may be attached to the pallet.

FIG. 18 is a perspective view of an alternative pallet embodiment configure to form an octagonal shape.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A detailed description of the preferred embodiments of the present invention will now be presented with reference to FIGS. 1-18.

Briefly described, in a preferred form, the present invention provides a force-resisting paperboard assembly that can be used both as a pallet and a dunnage support having high moisture resistance, which assembly is foldably constructed from two flat, die-cut blanks to form, for example, a pallet having a generally flat upper surface for supporting containers or packages a sufficient distance from the floor to permit the forks of a forklift to be inserted under them so that the pallet supporting the load can be moved from place to place. The pallet construction virtually eliminates negative environmental impact and minimizes the shipper's transportation expenses associated with conventional pallet constructions.

The following detailed descriptions of preferred embodiments will mainly refer to a force-resisting assembly formed as a pallet, yet use of the term *pallet* generally may be interchanged for the terms *dunnage support assembly*, as the construction of both is similar. When the construction of the pallet diverges from the construction of the dunnage support assembly, special notice will be made in the description.

The present invention further is directed to a machine for making the pallet of the present invention and a method of making the pallet.

Referring now in detail to the drawing figures, wherein like reference numerals represent like parts throughout the several views, FIG. 1 shows an assembled pallet **10** of the present invention, which pallet **10** generally comprises a lower frame member **12** and an upper frame member **14**, both of which are foldably constructed from blanks.

The pallet **10** is preferably constructed by folding a top blank **20** and a bottom blank **22**, which are respectively shown in a preferred form in FIGS. 2 and 3. The blanks **20,22** are die-cut and scored, according to known techniques, from flat sheets of paperboard, which material will be described in greater detail below, and may be assembled by the machine **80** of the present invention to be discussed in the following.

Preferably, the various elements comprising both the bottom and top blanks **20,22** are similar in form and function, thus a majority of the description of the composition of the blanks **20,22** will refer specifically only to the top blank **20**. Because the elements of both blanks **20,22** are similar, one reference numeral will be used to illustrate an element similar to both the top and bottom blanks **20,22**. When clarity is required between a similar element of both blanks **20,22**, for example, when describing the foldable construction of the pallet **10**, such differentiation between two elements will include the use of the letters "b" and "t" next to a reference numeral, thus referring to a bottom blank element or a top blank element. It will be understood upon reference to the description and the drawing figures that similar elements comprising both top and bottom blanks **20,22** are designed in similar ways.

For clarity, the detailed description of pallet **10** is broken into two subsections detailing the assembly blanks and the assembly construction.

The Assembly Blanks

The top blank **20** preferably comprises corrugated paperboard or solid paperboard. As used herein, "paperboard" refers to a web of cellulosic fibers in sheet form. The term *paperboard* includes paper and paperboard of different thicknesses. The preferred paperboard is virgin kraft paperboard of a weight known as linerboard. The corrugated linerboard known in the market at present comprises at least 70% post-consumer linerboard. It has more strength than 100% recycled board because its fibers are generally tougher and the board has fewer impurities. As is well known in the art, a chemical cooking process using sodium hydroxide and sodium sulfide produces kraft paperboard, and there are many different types of kraft paperboard manufactured with various additives and treatments for various applications. The pallet may also make use of reprocessed paperboard, that is, not virgin kraft paperboard.

The top blank **20** of FIG. 2 preferably comprises a bottom panel **30** and bottom foldable column panels **40,50,60,70**. Upon foldable construction, the bottom panel **30** of blank **20** remains generally parallel to and in proximity to the floor surface, while the foldable column panels **40,50,60,70** rise to form vertical ribs generally perpendicular to the floor surface. When the top blank **20** is foldably assembled, it forms the lower frame member **12** of the pallet **10**. The top blank **20** is generally rectangular in shape, and is bounded by first and second ends **32,34**, and first and second sides **36,38**.

It should be noted that in the following description, references to lengths, widths, and thickness might vary in orientation between the several elements of the pallet **10**. For example, the top blank **20** is shown and described as having a length equal to the length of sides **36,38**, a width equal to the length of ends **32,34**, and a thickness equal to the thickness of the blank comprising top blank **20**. Yet, when describing various elements of top blank **20**, some elements

may be described as having a length running parallel to, for example, ends **32,34** (instead of sides **36,38**), and a width running parallel to sides **36,38** (instead of ends **32,34**). Additionally, at times, the thickness of an element may relate to a measure in the direction of length or width of blank **20**, and not thickness in the sense of the thickness of blank **20**.

First, second, third, and fourth bottom foldable column panels **40,50,60,70** of the top blank **20** are shown each comprising three separate column panel sections. For example, first bottom foldable column panel **40** comprises column panel sections **42,44,46**.

The bottom panel **30** of the top blank **20** has a top face and a bottom face, and, as illustrated in FIG. 2, comprises edge panels **81,89**, jack panels **83,87**, and middle panel **85**. Upon manipulation into the assembly **10** of the present invention, the top face of the bottom panel **30** faces upward, inside the assembled invention, and the bottom face points upward, or if assembly **10** is turned over, lies atop the ground or other surface upon which the assembly rests. FIG. 2 illustrates an unassembled or unfolded top blank **20**, and therefore depicts the preferred foldable column panels **40,50,60,70** and the elements of the bottom panel **30** in the same plane. Edge panel **81** comprises edge flaps **102,104** and extends from left to right from first end **32** to first column panel sections **42,44,46** and the edge flaps **102,104**.

Jack panel **83** comprises two jack flaps **122,124** and has cut therethrough two jack passages **126,128** for the use of a floor jack to lift the constructed pallet **10**. Jack panel **83** extends between column panel sections **42,44,46** and jack flaps **122,124**, and second column panel **50**. Cutouts **112,114** lie between edge flaps **102,104** and jack flaps **122,124**, respectively.

An optional middle panel **85** comprises four generally identical flaps, middle flaps **142,144,152,154**. Middle panel **85** extends between second and third column panels **50,60** and the edges of flaps **142,144** to the edges of flaps **152,154**. Between jack panel **83** and middle flaps **142,144** lie cutouts **132,134**, respectively.

Jack panel **87** comprises two jack flaps **172,174** and has cut therethrough two jack passages **176,178**. Jack panel **87** extends between third column panel **60** and fourth column

panel 70 and the edges of jack flaps 172,174. Between middle flaps 152,154 and jack panel 87 lie cutouts 162,164, respectively.

Edge panel 89 extends from both fourth bottom column panel 70 and the edges of edge flaps 192,194 to end 34. Between jack flaps 172,174 and edge flaps 192,194 lie cutouts 182,184, respectively.

Neither the pallet nor the dunnage assembly of the present invention need comprise jack panels 83,87 with jack passages, as jack panels 83,87 may be integral throughout without any apertures for inserting a jack. Further, as described under the section on the assembly construction, the number of flaps associated with each panel can vary. At a minimum, adjacent panels need only comprises a single flap, extending from either panel, so the column panel can lock into an upwardly extending rib. For example, as shown in FIG. 2, adjacent panels 81,83 have between them both four flaps 102,104,122,124 extending from edge panel 81 and jack panel 83, respectively. Adjacent panels 83,85 have between them both two flaps 142,144 extending from middle panel 85. Yet in an alternative embodiment, only a single flap extending from either panel 81,83 and extending from either panel 83,85 is needed to lock the column panels 40,50, respectively, into ribs. As will be described, the at least one flap between adjacent panels will comprise a flap lock assembly.

Top and bottom blanks 20,22 preferably are symmetrical about both a vertical and horizontal line of bisection. Similar elements of the top blank 20 on either side of each line of bisection are generally identical mirror images of one another. Further, first and second column panels 40,50 are generally identical. Therefore, for purposes of brevity, only edge panel 81, first column panel 40, jack panel 83, and middle panel 85 will be described below in detail. It will be understood that columns 50,60,70, jack panel 87, and edge panel 89 are of similar construction to those described.

As shown in FIG. 2, edge panel 81 has two edge flaps 102,104 extending between column panel sections 42, 44, and 46. Edge sliding flap 41 is defined by edge end 103 and side

slits **101,105** cut into top blank **20**. Edge sliding flap **43** is defined by edge end **108** and side slits **107,109**. The end of edge panel **81** distal end **32** of top blank **20** further comprises score lines **202,242,282**. Side slits **101,105,107,109** and score lines **202,242,282** differentiate edge panel **81** from first column panel **40**. Score lines **202,242,282** preferably lie in a straight line perpendicular to the first and second sides **36,38** of top blank **20**.

First column panel **40** comprises column panel sections **42,44,46**. Foldable column panel **40** has a width W_{COL} illustrated as the width between score lines **202,204** of column panel section **42** and, therefore, each panel section **42,44,46** has a width equal to W_{COL} . As shown in FIG. 2, column panel section **42** is that portion of first column panel **40** enclosed by side portion **206** of side **36**, score lines **202,204**, slit **101**, and sidecut **111** of cutout **112**. Preferably, score lines **202,204** are parallel, and score line **202** and slit **101** are substantially perpendicular to each other, as are score line **204** and sidecut **111**.

As pointed out previously, embodiments of the assembly **10** may comprise only a single flap between adjacent panels, wherein the at least single flap will comprise flap lock assemblies, which flap lock assemblies **137,139** are described below and shown incorporated in jack flap **122**. Thus, if edge panel **81** had the only flap between the adjacent panels **81,83**, which flap extended from edge panel **81** at the location of edge flap **102**, the flap would appear in large part like jack flap **122** having locking assemblies **137,139**. Further, in this embodiment, score line **204** and sidecut **111** are substantially perpendicular to each other, while the angle α shown between score line **204** and sidecut **111** in FIG. 5 would exist between score line **202** and slit **101**, which angle α between score line **202** and slit **101** would also provide for a locking relationship of the flap extending from the edge panel over jack panel **83**, as jack flap **122** would not exist.

Generally centered within column panel section **42** is lock aperture **210**. Lock aperture **210** preferably incorporates a locking slot **212** located in lock aperture **210**. Column panel section **42** further includes column top panel **220** having a width W_{RTP} (FIG. 4) between score

lines **222,224**, spanning the length of the width of panel section **42**, yet interrupted through lock aperture **210**. Column top panel **220** further preferably divides panel section **42** into column side panels **302,304** adjacent column top panel **220**.

Upon manipulation of column panel section **42** via folding, score lines **202,204** are drawn together, thus raising rib top panel **220** upward from the flat plane of bottom panel **30**, as illustrated in FIGS. 4 and 9, while score lines **222,224** break and fold approximately 90 degrees. The column side panels **302,304** rise between score lines **202,204** and rib top panel **220**. In this configuration, column side panels **302,304** form rib sides **302,304**. Rib sides **302,304** have side edges. Lock aperture **210** provides a generally flat notch having a bottom in the middle of rib top panel **220**.

As shown in FIG. 2, column panel section **44** is that portion of first column panel **40** enclosed by slit **105**, sidecut **113** of cutout **112**, score lines **242,244**, slit **107**, and sidecut **115** of cutout **114**. Preferably, score lines **242,244** are parallel and side slits **105,107** are substantially perpendicular to score line **242**, as are score line **244** and knifecuts **113,115**.

Generally centered along both a first and third line of intersection running perpendicular to score lines **242,244**, while lines separate the length of score lines **242,244** into four equal segments (the second line of intersection cutting score lines **242,244** in half) within column panel section **44** are two locking slots **252,254**, both generally identical to locking slot **212** of lock aperture **210**. Column panel section **44** further includes column top panel **260** between score lines analogous to score lines **222,224**, spanning the length of panel section **44**, yet interrupted through locking slots **252,254**.

Upon manipulation of column panel section **44** through folding, the score lines are brought together, raising column top panel **260** upward from the flat plane of bottom panel **30**. Locking slots **252,254** provide vertical slots cut within rib top panel **260**. The orientation of locking slots **252,254** and column top panel **260** of column panel section **44** preferably align with

the locking slot **212** and column top panel **220** of column panel section **42** so that rib top panels **220,260** and locking slots **212,252,254** present continuity of the structure upon folding.

Jack panel **83** has jack flaps **122,124** and jack passages **126,128**. Jack flap **122** preferably comprises head edge **131**, side edges **113,111**, and jack flap lock assemblies **137,139**.

At the base of jack flap **122** are flap lock assemblies **137,139**. Flap lock assemblies **137, 139** preferably include wing tabs **156, 157**, which may be approximately equal to two times the thickness of bottom panel **30**. Wing tabs **156,157** provide an unexpected stability and integrity to locking the columns into place which essentially alleviates the need for adhesives. Flap lock assemblies are unexpectedly far superior to the slide lock assemblies, such as that described in U.S. Patent No. 6,029,582, for several reasons, including , but not limited to, the fact that the wing tabs maintain their integrity as opposed to the slide lock tabs which easily become damaged and rounded off during assembly; and the wing tabs simply hold their lock longer and more securely. When column panel section **42** is folded into a rib portion **40**, as further described under The Assembly Construction, the then upwardly extending column side panel **302** of rib portion **40** in proximity to slit **101** is locked into place by wing tab **156**.

Middle panel **85** shown in FIG. 2 comprises four middle flaps **142,144,152,154** and four middle locking flaps **90,91,92,93**. Each middle locking flap is generally identical to jack flap **122** described in detail above. Middle locking flaps **90,91,92,93** serve the same locking purpose as do jack flaps **122,124**. Middle locking flaps **90,91** lock into place the ribs formed by folding column panel **50**. Middle locking flaps **92,93** lock into place ribs formed by folding column panel **60**. During the folding and locking process of column panels **50, 60**, middle flaps **142,144,152,154** slide over an exterior portion of jack panels **83,87**, respectively.

Thus described, top blank **20** comprises a plurality of generally identical foldable column panel sections, flaps, and cutout portions.

Bottom blank **22** as shown in FIG. 3 comprises nearly an identical layout as top blank **20**. The bottom panel **30** of the bottom blank **22** has a top face and a bottom face. Upon

manipulation into the assembly **10** of the present invention, the top face of the bottom panel **30** faces downward, outside the assembled invention, and the bottom face faces inside the assembled invention. This reference to the top and bottom face of the bottom panel **30** of the bottom blank **22** is opposite the orientation of the top and bottom face of the bottom panel **30** of the top blank **20** because, upon construction of the assembly **10**, the top blank **20** is turned upside over the bottom blank **22**.

When assembly **10** is formed as a pallet, the top and bottom blanks **20,22** are preferably sized to foldably produce a conventional 40"×48" pallet. In such a configuration, depending on the thickness of paperboard used, the preferable dimensions of each blank **20,22** are 40"×77.25" for the top blank **20**, and 48"×69.25" for the bottom blank **22**. These dimensions provide for a 40"×48" pallet **10** upon folding the blanks **20,22** and assembling top blank **20** over bottom blank **22** after orientating top blank **20** ninety degrees relative to bottom blank **22**, as described under The Assembly Construction.

The number and general shape of each element of the present pallet **10** including the number and shape of column panels, column panel sections, jack passages, and the like are variable between alternative embodiments of the present pallet. For example, bottom panel **20** may comprise six column panels. The two column panels beyond the four illustrated in FIG. 2 would be located one between the first and second column panels **40,50** and one between third and fourth column panels **60,70**. Each would be shaped and orientated as the proximate first and fourth column panel **40,70**, respectively.

The number of locking slots per each bottom and top foldable column panel preferably equals the number of column panels comprising the opposing blank **20,22**. That is, if the top blank **20** comprises eight foldable column panels, then each column panel of the bottom blank **22** has eight locking slots.

The Assembly Construction

The blanks **20,22** can be foldably constructed to form a load-bearing assembly **10**, as will now be described in greater detail. FIG. 9 shows the top blank **20** of pallet **10** in a partially assembled configuration. Folding of blank **20** will be described from first side **32** to second side **34**, although the folding of blank **20** need not follow any particular order.

The first foldable column panel **40** is folded into a rib, rising into a generally perpendicular plane to bottom panel **30**, by folding column panel sections **42,44,46** upwards from bottom panel **30** about respective score lines **202,204, 242,244, and 282,284**. As first foldable column panel **40** begins to take shape as a rib, column top panel **220** of column panel section **42** is folded about score lines **222,224** and becomes rib top panel **220** that lies in a generally parallel plane to the plane of bottom panel **30**. Each column top panel of each panel section **44,46** is similarly folded.

The column panel **40** continues to fold upward from panel **30** as score lines **202,242,282** are brought nearer to score lines **204,244,284**, respectively. Preferably, each set of score lines abuts one another (for example, score line **202** abuts score line **204**), and side panels **302,304** are closely opposed, as seen in FIG. 12.

As rib **40** is folded, jack flaps **122,124** are necessarily brought toward edge flaps **102,104**, over cutouts **112,114**. The jack flaps are folded down over edge flaps **102,104** and the locking assemblies **137,139** of jack flaps **122**, and the corresponding locking assemblies of jack flap **124** (not numbered), lock into place the rib formed by folding column panel **40**.

The second column panel **50** is folded into a rib just as column panel **40**. Similar to the locking of jack flaps **122,124** over edge panel **81**, middle locking flaps **90,91** span across cutouts **132,134** and fold over jack panel middle panel **85**. This process is repeated until all the ribs are locked in an upright configuration producing lower frame **12** (FIG. 9).

The bottom blank **22** of an assembly **10** comprising bottom blank **22** folds into a locked configuration just as described for top blank **20**. This locking process is repeated for bottom blank **22**, thus providing the upper frame **14** of assembly **10**.

The folded configurations of lower and upper frames **12,14** are releasably secured against unfolding by the flap lock assemblies. The folded configurations of lower and upper frames **12,14** can be fixedly secured against unfolding by frame fixed securing means. For example, frame fixed securing means can comprise an adhesive placed on the top faces of edge flaps **102,104**, or the bottom faces of jack flaps **122,124**, or both, to fixedly secure rib **350** in its folded state by adhesively securing the position of edge flaps **102,104** over jack flaps **122,124**. Other frame fixed securing means can comprise tape, staples, other diecut locking configurations, and the like. As described above, the unexpected strength of the above described locking assemblies makes the use of securing means optional, and in some cases not preferred.

After the bottom and top blanks are folded, the assembly **10** is formed by rotating the bottom or top blank **20,22** ninety degrees relative to the other blank. Then the top blank **20** is flipped upside down so the ribs such as **42t** extend downward toward the upwardly extending ribs such as **42b** of bottom blank **22**. The blanks **20,22** are then brought together so the locking slots of each rib on one blank engage the locking slots of ribs of the other blank. As shown in FIG. 1, because the blanks are rotated 90 degrees relative to each other, the upper frame ribs and the lower frame ribs form crisscrossing rows and columns of ribs. The additional side walls formed by flaps **102,104**, for example, provide additional strength over the pallet of the '582 patent.

FIG. 13 illustrates a constructed blank or dunnage assembly **10**. A rib formed by column panel **40t** of top panel **42** engages the locking slots of rib portions formed by column panel sections **46b,56b,66b,76b** of bottom column panels **40b,50b,60b,70b**, respectively.

The assembled configuration of lower and upper frames **12,14** is releasably secured against separation by the interconnecting locking slots. The assembled configuration of lower and upper frames **12,14** can be fixedly secured against separation by assembly fixed securing means. For example, assembly fixed securing means can comprise an adhesive placed on the top surfaces of rib top panels of each panel section, to, for example, fixedly secure each rib top panel

of the upper frame **14** to the bottom panel **30** of the lower frame **12**. Other assembly fixed securing means can comprise tape, staples, diecut locks such as shown on FIGS. 1 and 2, comprising separation locks, and the like.

Furthermore, the assembled configuration of the lower and upper frames **12, 14** provide for a unique peripheral structure that adds additional stability to the assembled pallet. Namely the incorporation of edge panels which are folded and locked into place during the assembly of frame and bringing together of frames to form the pallet provide a tight secure construction at the periphery of the pallet, versus prior art pallets such as that described in U.S. Patent No. 6,029,582, wherein the periphery of the pallet is subject to compression and shear forces.

An additional feature of the subject pallet or dunnage system comprises the unique cutting and scoring of the column panels to define bridge cuts **94,95** (FIG.8). When using high strength corrugated materials, and other strong materials, the implementation of scoring alone makes folding and assembly of the pallet very difficult. This is because, even with scoring, the material still resists folding. With the unique bridge cuts feature, the material is much easier to fold at the desired strategic locations. This results in an increase of overall stability and integrity of the pallet, as the material lies into place better, and damage brought about by forcing the material is avoided.

It will be understood by one of skill in the art that the terms “upper” and “lower” and “bottom” and “top” are relative, and that the pallet **10** may be used in either orientation. It is in fact believed preferable to have the orientation inverted from that which is shown above, as the apertures **221** in element **22** provide access to pallet jack wheels to make contact with the floor. The apertures **221** are an advantageous feature, but the present pallet may be designed without providing such apertures.

FIG. 15 shows a diagram of two frames **97,98** similar to frames **12,14** described above. Frame **97** comprises tab locks such as **510, 511, 512**. Preferably, the tab locks are provided proximate to the periphery of frames **97,98**. In locking together frames **97,98**, edge flap **516** is

folded over, tab locks **510, 511, 512** are pushed through holes **513,514,515**, respectively, and locked into place. This is repeated at every edge flap until pallet is fully assembled. Tab locks provide additional strength and stability to the assembled pallet. The edge flap **516** comprises slots such as **520,521**. These slots slide into slots **519,522**, respectively until the most interior portions **523,524** abut against most interior portions **525,526** respectively. Slots **519,520,521,522** allow the edge flap **516** to fully slide into position, which increases structural stability.

Other Embodiments and features

In some instances, it is desirable to have a pallet that possesses an even flat top or bottom surface. FIG. 16 shows a diagram of a flat attachment embodiment **600** that may be attached to the top of an assembled pallet. The flat attachment **600** is locked into place by tab locks **601,602,603,604,605** which are locked into holes defined in the assembled pallet.

For some applications, it is desirable to have a more flat surface as well as a means to hold items onto the pallet. FIG. 17 shows a diagram of a tray attachment embodiment **700** that may be attached to the top of pallet as described herein. As with the flat attachment **600**, tray attachment comprises tab locks **701,702,703,704,705,706** to secure the attachment into place. Furthermore, the tray attachment comprises tray side walls **707,708,709,710** which may be folded and secured to center panel **711**. Looking to side wall **707** for example, it comprises an edge portion **712**, medial portion **713**. The edge portion comprises secure tabs **714,715**. Upon assembly, the edge portion **712** folds over medial portion and tabs **714,715** lock into slits **716,717** of center panel **711**. The wing flaps **718,719** will fold under side walls **708,709**, respectively. Sidewalls **708,709,710** are folded, similarly.

Further, those skilled in the art will appreciate that several different types of attachments may be provided and secured to the present pallet. For example, different types of partitions may be constructed to attach to the subject pallet system. Partitions could be used for example to

partition 2 liter bottle containers, or containers of many different sizes and shapes. Further, a top partition could be constructed whereby partitions are secured from a top cover to go over the covered goods. Further still, layers of goods and pallets could be formed with partitions secured to both the top and bottom of middle pallets.

Those skilled in the art will appreciate that the many advantageous features of the present pallet may be provided in pallets of different shapes and forms. FIG. 18 shows a pallet configured in dimensions to form an octagonal shape. The octagonal shape is particularly preferred as the "honeycomb" nature of the shape allows for tight placement of pallets in trucks, warehouses, ships etc. The ribs of the octagon may be defined, assembled, and locked into place in accord with the teachings above. Those skilled in the art will appreciate that the pallet may take the form of other shapes, including, but not limited to, circles, triangles, squares, and hexagon and other polygonal shapes.

In the above described preferred embodiments, assembled pallets are shown that have four passages, thus allowing a forklift or other device to pass through either axis of the pallet. In some instances, it is advantageous to have a side surface on which advertising or other information may be displayed or printed. The edge panels of the pallet can be configured to provide opposing closed sides, such that passages are defined on only one axis not two. The closed side provides a full side surface to display information.

Furthermore, the configuration of the subject pallets provides an additional benefit to the user. In prior art pallets, the ends of the pallets are not closed end, and therefore do not provide a passage way that is easy to see to the user, such as a forklift operator. In prior art pallets, such as that taught in U.S. Patent NO. 6,029,582, the passageways are hard to see. As a result, a forklift operator can easily miss the passageway, thereby ramming the forklift into the pallet in the wrong position and damaging the pallet. The subject invention provides an easy to visualize passageway even from higher elevations so that damage of this sort is avoided.

The teachings of the references cited throughout the specification are incorporated herein by this reference to the extent they are not inconsistent with the teachings herein. It should be understood that the examples and embodiments described herein are for illustrative purposes only and that various modifications or changes in light thereof will be suggested to persons skilled in the art and are to be included within the spirit and purview of this application and the scope of the appended claims.